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 U1S S1484 S1519 S1615 S1922 S1945 S1967
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 G3R RBU
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(54) Interior atmosphere control system

(57) An interior atmosphere control system contains a group 1 of sensors 11, 12, 13 to measure indoor and outdoor air temperature, humidity, air pressure, oxygen content, carbon-dioxide content, static electric charge, indoor wall temperature, sound and light. These measured results, through a signal transfer interface 2, are sent to a microcomputer 3 which also accepts the user's command as input data through a user's interface 31. The microcomputer, based on the monitor/control program and data prestored in its memory unit 35, the sensed values, and the user's command, will then execute the necessary calculation, comparison and decision, and output adequate time variant control signals, through an output interface 4, to actuate a series 5 of actuators 51, 52, 53 to adjust the indoor temperature, humidity, air pressure, oxygen content, carbon-dioxide content, wind speed, static electric charge, magnetic field, sound, odor, and light which will generate different atmospheric modes, for example, to make people feel comfortable, refreshed, awakened, energetic, sleepy, romantic, uneasy, or even frightened; the room temperature, humidity, wind speed and other factors can be adjusted to cause the human body to respond as desired.

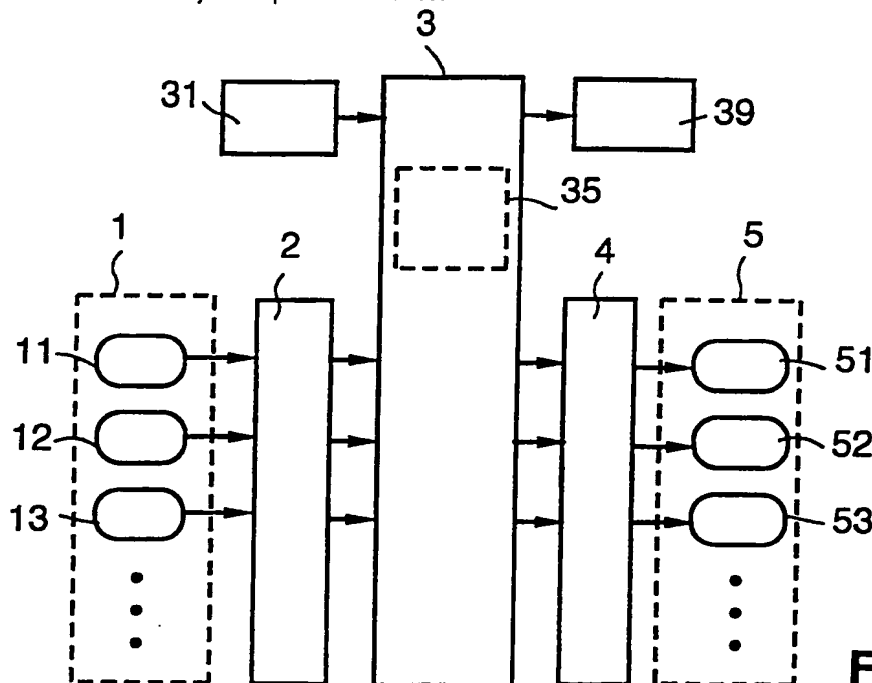


FIG. 1

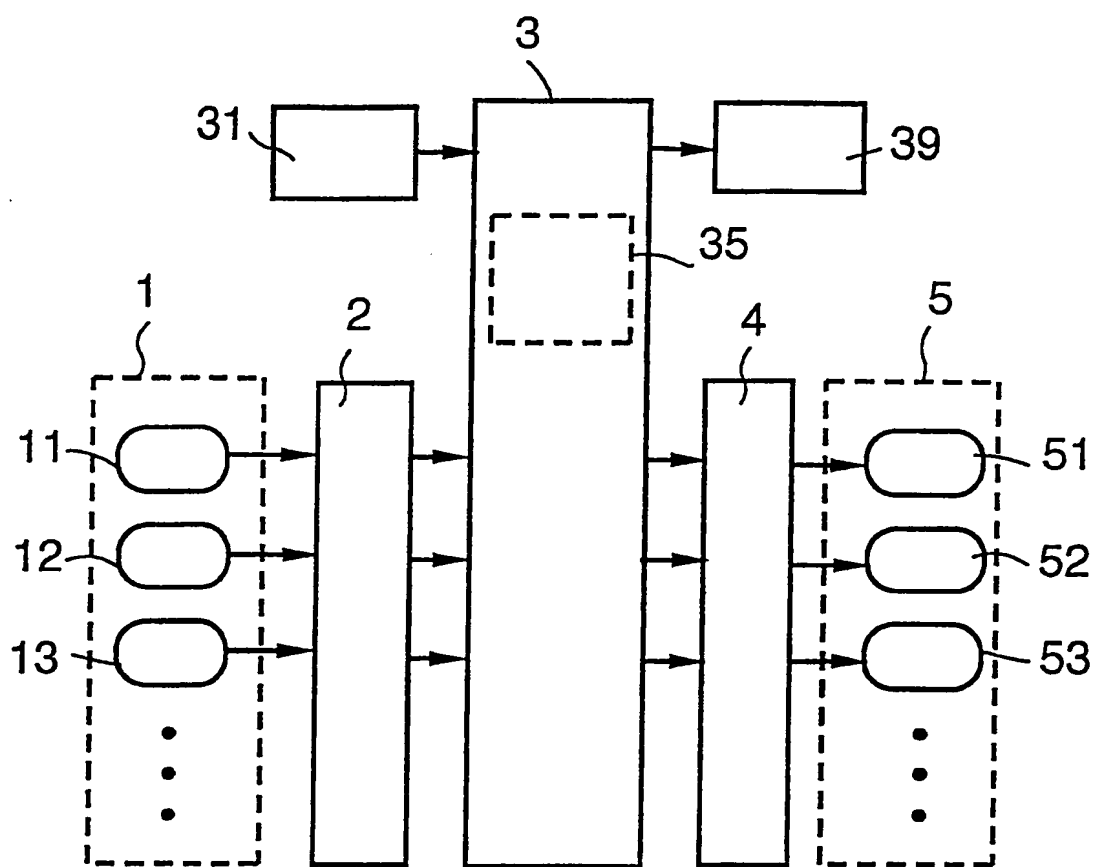


FIG. 1

Table of Atmosphere Modulating Factors

Atmospheric Requirement	Main Control Factors [#]	Controlled Value/Status
Comfort	Temperature (D.B.) Relative Humidity Sound Light	Summer 22-26°C, winter 20-24°C 35-70% relative to temperature Soft Gentle
Refreshment	Temperature (D.B.) Relative Humidity Odor Sound	Summer 20-27°C, winter 18-24°C 35-70% relative to temperature fresh or favorite flavor soft
Concentration	Temperature (D.B.) Relative Humidity Oxygen Air Pressure Light Color	18-27°C 30-75% relative to temperature 22-26% Higher than outdoor air pressure Bright Harmonious
Drowsiness	Temperature (D.B.) Carbon Dioxide Relative Humidity Light Sound	23-27°C 0.1-0.5% 50-70% Obscure Soft
Uneasiness	Temperature (D.B.) Relative Humidity Air Pressure Sound	25-32°C 70-85% Lower than outdoor air pressure Noisy
Scare	Temperature (D.B.) Relative Humidity Air Pressure Light Static Electric Charge	14-20°C 75-90% Lower than outdoor air pressure Obscure and changing Strong

[#] The controlled value/status of the control factors also varies cyclically with variable amplitude and frequency.

FIG. 2

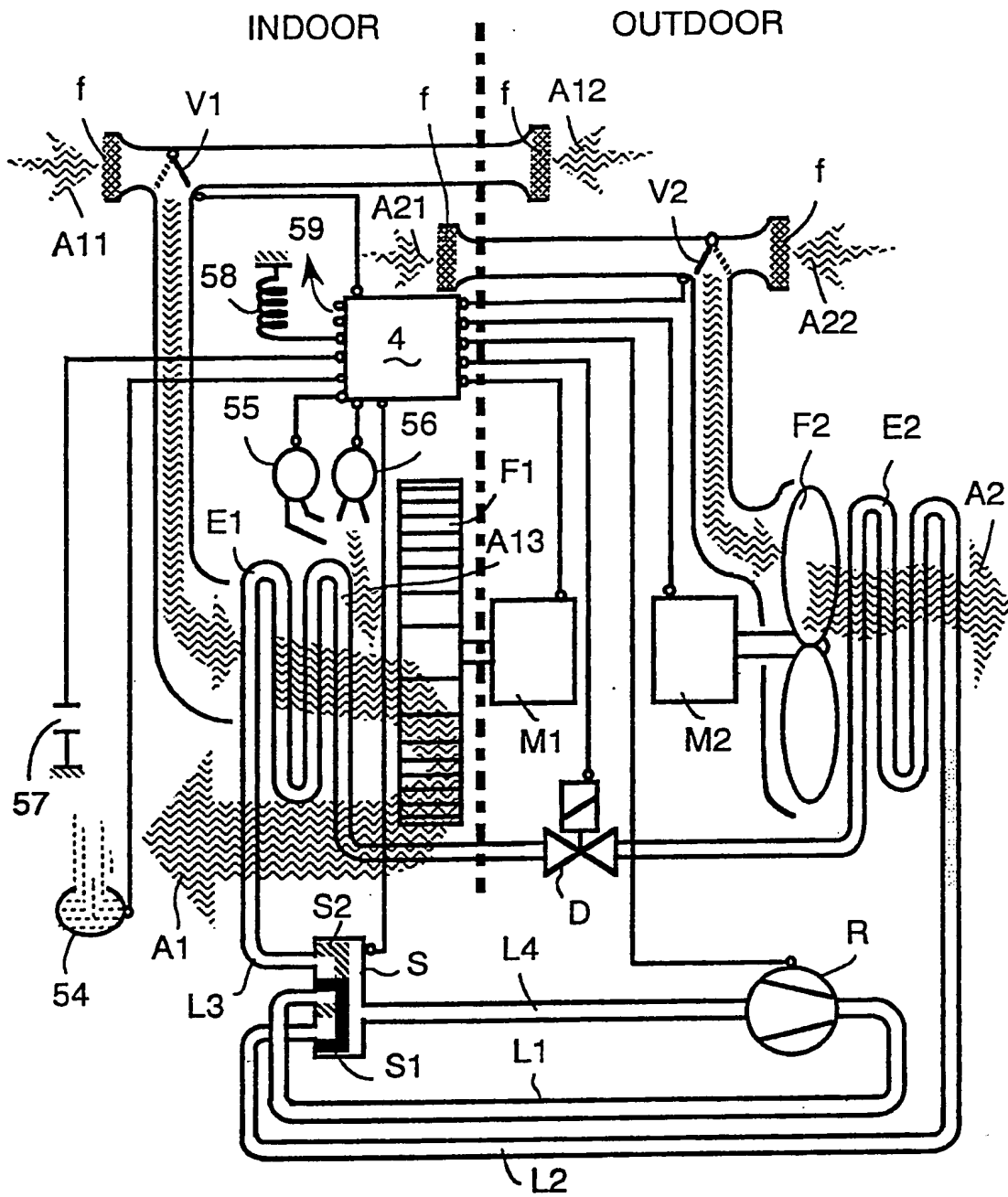


FIG. 3

4:4

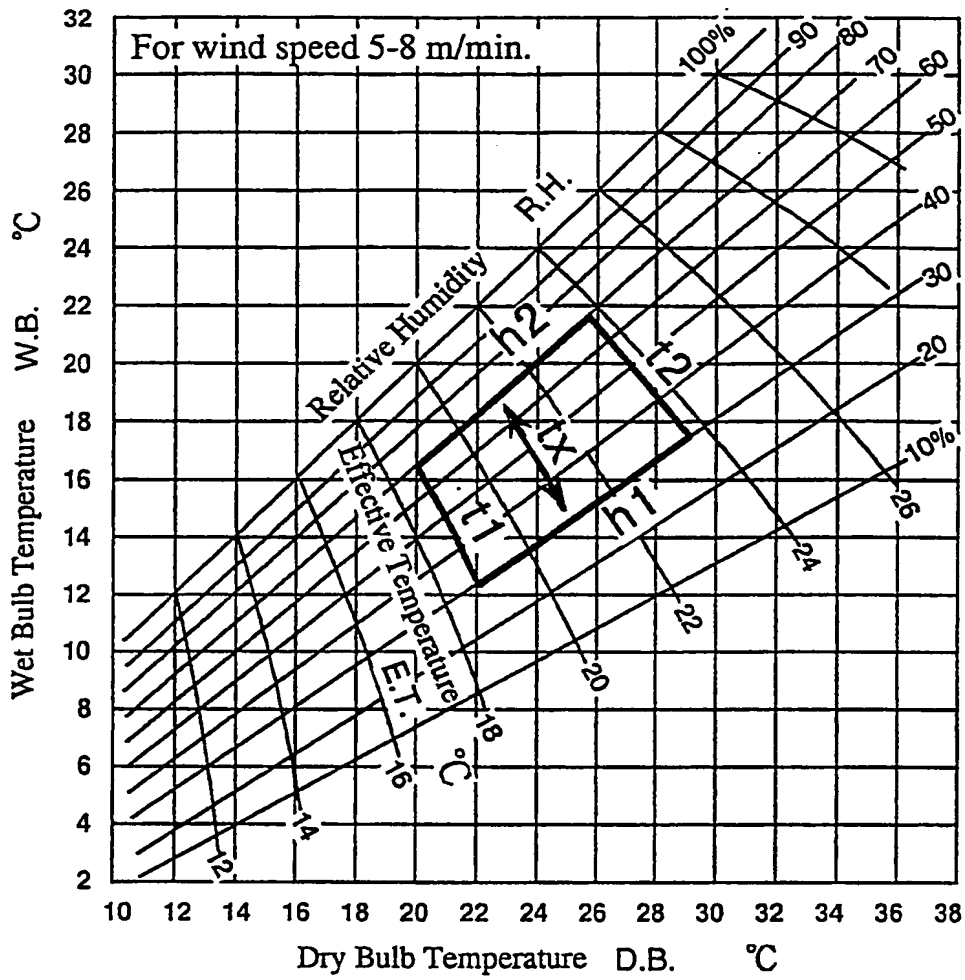


FIG. 4-a

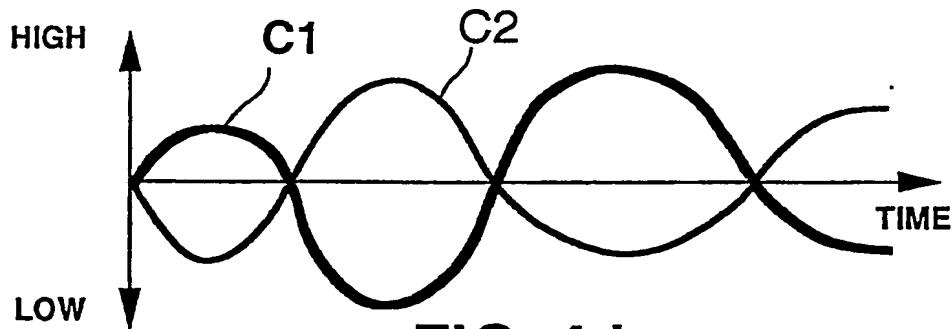


FIG. 4-b

INTERIOR ATMOSPHERE CONTROL SYSTEM

This invention relates to an automatic atmosphere conditioner which is capable of adjusting the atmospheric condition in a room. This invention
5 discloses a method and a device to generate and control indoor atmosphere. The so-called atmosphere is not only the weather phenomenon or the air condition, but, more particularly, the environment of physiological and psychological states for the human. For example, we say, "the business negotiation goes under a harmonious atmosphere."

10 It is generally known that the human body is easy to be affected by various environment and generates various emotion. People can be in high spirits or absent-minded or in relaxation by the environmental factors such as temperature (air temperature, wall temperature), humidity, air pressure, wind speed, oxygen content, carbon-dioxide content, static electrical ion,
15 sound, odor, light, magnetic field, etc. In consequence, those factors can be regulated to a specified status to make people concentrate on study, work or make them feel relaxed, drowsy, etc.

The human body which can be considered as a heat producer is usually exposed to an environment where the temperature is lower than the
20 body, and then dissipates heat by continuous radiation, conduct, convection, breath and sweat. When temperature difference between body and environment is large and the heat rate generated by the body is lower than the heat dissipation rate, people will feel cold; when temperature difference between body and environment reaches a certain degree where the heat
25 generation rate and the heat dissipation rate keep balance, people will feel

comfortable; and when temperature difference mentioned is small or the temperature of environment is higher than that of body, people will feel irritable because the dissipated heat is not exhausted quickly enough. When people feel cold, the skin pores will naturally shrink to reduce sweat and lower heat dissipation rate; on the other hand, an intense exercise increases the body heat which can be dissipated by profuse sweat; that is, the human body has self-modulated function of dissipating heat rate to sustain the body temperature. However, in order to easily modulate body heat rate and make people feel comfortable, appropriate air humidity and temperature are two of the most important factors. The indoor wall temperature (includes temperature of all-sided walls, ceiling and floor) also has influence, however, since the wall temperature will not be adjusted quickly, it will not be herein considered as a controlled factor of this invention to affect the thermal balance of body. What human body really felt as the so called effective temperature is referred to the dry bulb temperature with 100% relative humidity in the still air. With certain relation between humidity and temperature, people will feel the same effective temperature. For example, with effective temperature 22 °C, the dry bulb temperature may vary increasingly from 23.6 °C to 26.6 °C if the relative humidity varies decreasingly from 70% to 30% (as shown in the appended FIG. 4-a). The relation of temperature and humidity, which can be controlled to provide a constant heat dissipation rate for human body to obtain a thermal balance condition, can be explored to generate favorably regulating response by stimulating skin or other sensory organs (such as shrinkage of skin pores, tension or relaxation of skin) and inspire spirits.

In the past, when people feel sleepy due to environment or excessive fatigue, the ways to keep awake is to wash face with cold water, stimulate skin mechanically or get up to exercise. However, it often fails to get the desired effect due to laziness which is the human nature, short last or
5 unavailable conditions.

Furthermore, traditional air conditioning system is at most to control temperature or humidity to a certain presetting reading (the real control result is the controlled variables that varies slightly around the desired value.) Because of this, human body will constantly dissipate heat by almost
10 fixedly expanding skin pores (sweat gland). People will feel numb or drowsy as the skin pores keep the same expansion for a long time; and they once leave the controlled environment, subject to outdoors' quite different temperature and humidity, they are easy to be attacked by heat-stroke, or getting cold.

15 Air pressure and air content also have great effect on human body. When pressure drops or oxygen content lessens, people will feel sick because of difficulty of breath. On the other hand, if oxygen is supplied sufficiently or the indoor pressure is increased adequately, people will breathe smoothly, keep alert and improve working efficiency. The
20 concentration of carbon dioxide in the natural world is 0.03% ~ 0.05%. If indoor carbon dioxide concentration is up to 0.2% ~ 0.5%, people will feel bored and drowsy; if concentration exceeds 0.5%, it will cause physiological malfunctions or even lead to death. The conventional air conditioner can not control air pressure or air content. The air exchange
25 design of a conventional air conditioner only opens a valve between indoor

and outdoor and can not control the amount and direction of inducting or extracting air. Therefore, it can not effectively expel the indoor dirty air or induce clean and fresh outdoor air.

5 Wind speed also affects environment. When it is as gentle as breeze, people will feel cozy and drowsy; when it becomes gusty wind, people will feel nervous and uneasy because it seems that an imminent catastrophe is just ahead.

10 The human skin not only perceives cold/hot feeling and sense of touch, the body hairs can also be made to stand on end. People may shudder with fear or feel excitement when the hair is affected by static electric field or ion attach. Besides, magnetic field may affect human's body or spirit, but the effect has not been fully understood yet.

15 The odor also affects one's mood; such as offensive smell may cause nausea; or people in the environment where simulates garden or forest will feel pleasant and refreshing.

Noise may also bother one's feeling; soft music makes people feel leisurely; classic music makes people feel elegant; and rock and roll make people eager to dance. Apparently, sound and music affect people's mood quite a bit.

20 Moreover, indoor light may also affect people's physiological reaction; such as obscure light makes people feel drowsy; soft light and color make people feel romantic; bright light and color make people feel sober; and abundant light makes people concentrate on work or study.

25 However, there is no such atmosphere control system in the present market that can wholly modulate/control the variation of above mentioned

atmospheric factors. The indoor environment consequently can not be adjusted to meet the users' respective requirements.

Based on those reasons, the present invention first provides an atmosphere control system that controls the changing factors of indoor atmospheric factors and generate different atmospheric effects to make people feel cozy, refreshing, concentrating, sleepy, uneasy, or even scared.

The invention secondly provides an atmosphere control system that adjusts the physiological reaction of human body based on the control and adjustment (manipulation) of environmental temperature, humidity, wind speed, etc. and adequate heat dissipation rate of human body to meet the principles of thermal balance.

The invention thirdly provides an atmosphere control system that modulates/controls the difference of indoor/outdoor temperature and humidity and the wind speed that blows to the user. It can help the user avoid heat-stroke or catching cold while getting in or out of the room.

The invention fourthly provides an atmosphere control system that controls the indoor air pressure and purifies air content by inducing or extracting adequate amount of air.

The invention fifthly provides an atmosphere control system that adjusts specified atmosphere based on integrated control of indoor sound, light, odor, static electricity, magnetic field, etc.

The invention sixthly provides an atmosphere control system that generates variously odorous atmosphere or reaches the effect of killing germs or insects by shooting out or extracting various odor, disinfectant or insecticide automatically.

To achieve the above mentioned objects, the invented indoor atmosphere control system comprises a group of sensors to detect/measure indoor/outdoor air temperature, humidity, air pressure, oxygen content, carbon dioxide content, air cleanness and static electric charge respectively; and a group of sensors to detect/measure indoor wall temperature, sound volume and light respectively. The sensed signals will be sent to a microcomputer through a signal transfer interface. The microcomputer receives user's requirement through a user interface, calculates the sensed value of each sensor, compares with the prestored data and outputs adequate control signals through an actuation interface to actuate a series of actuators which modulate indoor temperature, humidity, air pressure, oxygen content, carbon dioxide content, wind speed, static electric charge, magnetic field, sound, odor, light, etc. Different indoor atmosphere effects will be generated thereby.

The invention will be better understood and further objects and advantages thereof will become more apparent from the ensuing detailed description of a preferred embodiment taken in conjunction with the drawings, in which:

FIG. 1 is a block diagram illustrating the basic construction of the invention;

FIG. 2 is a table listing an example of the modulation of different atmosphere control factors of the invention;

FIG. 3 is a constructional diagram of an embodiment of the invention;

FIG. 4a and 4b are fundamental diagram and curves showing the

indoor temperature and humidity to be controlled based on the physiological function of human body.

FIG.1 shows the basic construction of the present invention comprising: a group of sensing devices 1 which consists of sensors 11, 12, 13... detecting and measuring the value of indoor/outdoor air temperature, humidity, pressure, oxygen content, carbon dioxide content, static electric charge, indoor sound volume and light respectively. All the sensed signals will be fetched by a microcomputer 3 through a signal transfer interface 2. The requirement input by the user's interface 31 will be received by the microcomputer 3 which will measure/detect the sensed values of the sensing devices 1 based on prestored program and data in a memory unit 35 and output adequate control signals through an actuation interface 4 to actuate a series of actuation devices 5 which contain various actuators 51, 52, 53....to modulate indoor temperature, humidity, air pressure, oxygen content, carbon dioxide content, wind speed, static electric charge (Ion-concentration), magnetic field, sound, odor, light, etc. The output through microcomputer 3 can also be displayed by a display 39.

The program and data prestored in the memory unit 35 includes the ranges of various control factors corresponding to various atmosphere requirements. (such as comfort, freshness, concentration, sleep, disturbance, or scare) For example, as shown in FIG. 2, when the indoor temperature is controlled between 22~26 °C in the summer or 20~24 °C in the winter, the humidity is relatively modulated between 70~35%, (this provides an effective temperature on human body around 19~22 °C) and soft music is provided in the meantime, and as a matter of course, a

comfortable atmosphere is generated. On the contrary, it will make people feel disturbed if the indoor temperature is kept around 25~32 °C, humidity around 70~85%, the air pressure is lowered a little bit and more noise is made. These various items and their ranges can be modified, based on the effect of different experiments, to meet the requirements of different persons, jobs, time and locations. Moreover, the monitoring program and data in the memory unit 35 also include switching procedures; for example, while executing "sleep atmosphere", it can start from "drowsy atmosphere", and then smoothly change to the next adequate modes and finally switch to "awakened atmosphere" to make people wake up.

The modulation of temperature, humidity, wind speed, etc. in this invention can be invented based on the operation of conventional air conditioner. As an embodiment of this invention shown in FIG. 3, the air conditioner is basically constructed by a refrigerant (R-22) compressor R, an indoor heat exchanger E1 and its fan F1 and motor M1; an outdoor heat exchanger E2 and its fan F2 and motor M2; a 4-way directional valve S, an expansion valve D and unshown refrigerant circulated in the tubes. 4-way valve S controls the flow directions of high temperature high pressure refrigerant output from compressor R; that is, when the valve S is in the position S1, the refrigerant compressed by compressor R and output through tube L1 will be connected to tube L2 and reach outdoor heat exchanger E2 to be condensed, (the outdoor air exhaust A2 is warm air) and then, through expansion valve D, reach heat exchanger E1 to be evaporated. (the indoor air supply A1 is cold air); after that, the low temperature low pressure refrigerant is connected to tube L4 and drawn

back to compressor R. This is the circulation for cooling. On the contrary, when the valve S is in the position S2, tube L1 will be connected to tube L3, tube L2 will be connected to tube L4, and this forms circulation for heating. The generation of indoor warm air can also use an unshown electric heating apparatus. The aforesaid construction is of prior arts. This invention further has a humidifier 54 and/or an unshown dehumidifier. (In other way, the indoor humidity can be modulated by mixing original indoor air with the dehumidified indoor air coming through the indoor heat exchanger E1.) This invention can also fully control difference of indoor/outdoor air pressure and air induction/exhaust (by exchanging or mixing air) based on an inlet valve (flap) V1, an outlet valve (flap) V2 and piping between them: the valve V1 enables the indoor air supply A1 to come from indoor air return A11, outdoor air induction A12, or a mixture of those two in any desired ratio; the valve V2 enables the outdoor air exhaust A2 to come from indoor air A21, outdoor air A22, or a mixture of those two in any desired ratio, and, in consequence, indoor air pressure can be controlled and indoor air can be purified thereof (each opening of inlet/outlet air has a filter F to filter out the dirt in the air); and since the air induction/exhaust of indoor/outdoor fans F1 and F2 are controlled by the rotation of motors M1 and M2 respectively, the indoor temperature, humidity, air pressure, air content, etc., together with the actuation of a humidifier 54 and an oxygen supply device 55, can be modulated to any condition conforming to outdoor. For example, when some factors of outdoor air condition (temperature, humidity, oxygen content, carbon dioxide content, etc.) is closer to the required value than those in the present indoor condition, the

outside opening of valve V1 will open appropriately to attract outdoor air A12 by means of fan F1, or the inside opening of valve V2 will open appropriately at the same time to extract indoor air A21 through fan F2, and then it shows the effect of exchanging air or mixing air; when the indoor air pressure intends to increase, the valve V1 for outdoor air A12 increasingly opens and the valve V2 for indoor air A21 shuts down gradually, or the motor M1 speeds up at the same time, and the outdoor air will be forced to bring indoors; on the contrary, when the indoor air intends to be extracted out or the indoor air pressure intends to be lowered, the valve V2 for indoor air A21 increasingly opens and the valve V1 for outdoor A12 shuts down gradually, or the motor M2 speeds up at the same time, and the indoor air will be forced to be extracted outdoors. The temperature of indoor air supply A1 is decided by the mixed temperature of indoor and outdoor air A11, A12 and the heat-exchange rate of indoor heat exchanger E1. The heat-exchange rate is decided by the rotation speed of motor M1 and opening rate of expansion valve D. The humidity of air supply A1 is decided by the mixed humidity of indoor and outdoor air A11, A12, and the humidifying rate of humidifier 54 or dehumidifying rate operated in the indoor heat exchanger E1. Besides, an oxygen supply device 55 and an odor supply device 56 can provide the required content of oxygen, spray or liquid A13 of specified odor or drug which will be mixed with indoor air supply A1 and generates specified atmosphere. The microcomputer 3 (as shown in FIG.1) receives the signals of above mentioned control and actuation through indoor and outdoor sensing devices 1 and, based on the requirement, sends out appropriate control signals to the

unshown actuation interface 4 to take required actuation; for example, an unshown human body sensor of the sensing devices 1 can scan and detect the number of indoor persons and automatically control the amount of air exchange. (The amount of air exchange therefore is in proportion to the number of indoor persons.) The actuators further include an ion generator 57 which provides required static electric charge for the indoor atmosphere; a magnetic field regulator 58 regulates the intensity and direction of indoor magnetic field; and unshown sound and light regulators 59 can generate atmosphere of specified sound, light and color respectively. The humidifier 54 and odor supply device 56 can utilize a moisturised net, a nozzle or an ultrasonic humidifier. The oxygen supply device 55 can utilize an air storage tank or an oxygen generator from electrolysis. The static electric charge generator 57 can function with high voltage ionized air to generate negative ion. The magnetic regulator 58 can function with electromagnet. The sound, light and other regulators 59 can utilize any existed technologies which are not necessary to be described further.

The above mentioned air exchange and odor supply device 56 can shoot out and extract odor automatically to generate different atmosphere or obtain the effect of killing germs or insects; that is, the odor supply device 56 can generate required odor based on time setting and preset amount of odor; or when nobody is home, the disinfectant or the insecticide will shoot out and hold for a preset period of time till the indoor germs or insects are all dead; the device will then operate air exchange automatically, and the indoor air will keep refreshing when someone is back.

This invention regulates and controls the indoor temperature and

humidity based on the principles of sweat dissipation rate and respiration (thermal balance) of human body: that is, the body temperature, wall temperature, air temperature, humidity and wind speed are regulated with time-variation control to fit the physiological function of human body such as shrinkage/openness of skin pores and tense/relaxation of skin. This invention will modulate difference of indoor temperature, humidity and the wind speed blowing to human body based on those outdoor variant factors. In consequence, the human can avoid heat-stroke or catching cold while getting in or out indoors. The characteristics of these controls with respect to the relationship of domain of temperature and humidity will be further described in FIG. 4.

FIG. 4-a shows relationship among dry bulb temperature (D.B. ; horizontal axis), wet bulb temperature (W.B. ; vertical axis), relative humidity (R.H. ; oblique line directing to upper right) and effective temperature (E.T. curve line directing to lower right) felt by human body when the wind speed keeps 5-8m/min. Through statistical evaluation, the domain of temperature and humidity to be cozily felt by people is obtained as shown in the figure which is within the zone of t_1 - h_1 - t_2 - h_2 surrounded by the domain of effective temperature and relative humidity (It is of normal distribution. The central value of the cozy area means the favorite of most people.) The area may vary with the seasonal dress, racial custom, etc. This invention is to control temperature, humidity and wind speed relatively and provides so-called effective temperature felt by the human body. (As shown in FIG. 4-b, there are curves of the same effective temperature t_x which may be obtained by increasing temperature C_1 with

decreasing humidity C2 or decreasing temperature C1 with increasing humidity C2.) This will keep proper heat dissipation rate for human body and makes people feel comfortable. Consequently, temperature and humidity can be regulated anytime to stimulate the skin pores of human body to inspire spirit. On the other hand, as the conventional air conditioner fixes the value of temperature and humidity, the sweat gland and skin of human body keeps expanding or shrinking all the time. People will feel numb and drowsy, and once they leave the room, they are not able to adapt themselves to the sharp impact of outdoor temperature and humidity and may cause heat-stroke or get cold. As a result, this invention will gradually adjust the wind speed that blows to the user while he gets into or out of the room; that is, to help people adapt themselves to environment, it will reduce difference between indoor/outdoor temperature and humidity. (It can be detected by an unshown sensor for movement of human body.)

The above mentioned modulation of indoor temperature and humidity does not mean to be fixed to an effective temperature, but keep the indoor temperature and humidity in an area (such as the shown comfort zone) conforming to the outdoor situation. The skin pores and skin should be stimulated in accordance with the reaction rate of human body; for example, the period of each sinuous variation can be around 10 ~ 60 minutes -- practically, the amplitude and frequency can be adjusted based on various requirements.

The invented atmosphere control system can modulate to set a specified atmosphere through integrated control of indoor temperature, humidity, air pressure, air content, sound, light, odor, static electricity,

magnetic field, etc. It can be applied to many places; such as in the study room, the classroom or the working place, it can concentrate on encouragement and improvement of working efficiency; in the restaurant, it can provide refreshing atmosphere to give an appetite; in the amusement place, it can provide refreshing or specified atmosphere to make people feel joyful; in the vehicle or boat, it can provide concentrative or refreshing atmosphere to avoid drowsiness or carsickness; in the bedroom, it can provide drowsy or comfortable atmosphere to make people feel sleepy or promote romantic feelings; in the interrogation room, it can provide different atmosphere to make the suspect confess without covering up; and in the conference or meeting room, it can provide refreshing or harmonious atmosphere to enhance the negotiating effect and reduce conflict.

While preferred embodiments of the invention have been described in detail, it is particularly understood that the invention is not limited thereto or thereby, and it is evident to those skilled in the art that various changes and modifications may be made therein without departing from the invention.

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CLAIMS

1. A system for modulating the atmospheric condition of a room,
5 comprising:

(a) a group of sensors, wherein at least consisting of sensors to detect and measure indoor and outdoor temperature, humidity, air pressure and carbon dioxide content, and the output signals generated correspondingly;

(b) a user interface providing the user to set requirements;

10 (c) a microcomputer, wherein consisting of a memory unit of prestored monitoring program and data for retrieving signals of said sensors and said user interface; and sending out control signals through operation of monitoring and calculation based on said program and said data in said memory unit;

15 (d) a group of actuators, wherein at least consisting of actuators to modulate indoor temperature, humidity, air pressure, oxygen content, carbon dioxide, wind speed, and outdoor air exchange; and actuating said actuators, based on control signals output from said microcomputer, to modulate indoor atmosphere and meet the users' requirements.

20 2. A system as defined in claim 1, wherein said group of sensors further comprising at least one sensor for detecting and measuring indoor and outdoor oxygen content, static electric charge, indoor wall temperature, sound volume, brightness and movement of human body.

25 3. A system as defined in claim 1, wherein said group of actuators further comprising at least one actuator for modulating indoor wall

temperature, air content, odor, static electric charge, sound, light, color and magnetic field.

4. A system as defined in claim 1, wherein said prestored monitoring program and data in said microcomputer memory unit comprising expected
5 sensed values of said group of sensors and control algorithms of said group of actuators for selectively making people feel cozy, refreshing, concentrating, drowsy, uneasy, and frightened.

5. A system as defined in claim 1, wherein said group of actuators for modulating indoor temperature and humidity are controlled to relatively
10 increase and decrease temperature and humidity (to increase temperature while decreasing humidity, and decrease temperature while increasing humidity) to sustain a comfortable heat dissipation rate of human body and inspire one's spirit by properly stimulating one's skin and sensory organs.

6. A system as defined in claim 1, wherein said group of actuators
15 for modulating indoor temperature, humidity and wind speed, are controlled to gradually and automatically adjust the wind speed that blows to the user for reducing difference between indoor and outdoor temperature and humidity felt by human body, and help people adapt themselves to the environment as they get in or out of the room.

20 7. A system as defined in claim 1, wherein said group of actuators for outdoor air exchange include at least two sets of control valves (flaps) and fans for air induction and air exhaust; wherein, in order to control indoor air pressure and purify indoor air, at least one set is to control outdoor air to get indoors, and at least the other one is to control indoor air
25 to exhaust outdoors; and the amount of said air exchange is automatically

modulated based on the number of indoor persons detected by said group of sensors.

8. A system as defined in claim 4, wherein said prestored monitoring program and data in said microcomputer memory unit further including
5 switching procedures to adequately and smoothly change one atmospheric mode into another one.

9. A system as defined in claim 8, wherein said switching procedures including a procedure of killing insects and germs -- when nobody is in the room, a certain amount of disinfectant and insecticide will shoot out and
10 hold for a preset period of time till the indoor germs and insects are all dead, and then the indoor air will be exchanged with outdoor fresh air before someone is back.

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Patents Act 1977
Examiner's report to the Comptroller under
Section 17 (The Search Report)

Application number

9106955.9

<p>Relevant Technical fields</p> <p>(i) UK Cl (Edition K) G3N (NGE2, NGB2, NGB2A, GCA) G3R (RBU)</p> <p>(ii) Int Cl (Edition 5) G05D, F24F</p> <p>Databases (see over)</p> <p>(i) UK Patent Office</p> <p>(ii) WPI, INSPEC</p>	<p>Search Examiner</p> <p>DR E P PLUMMER</p> <p>Date of Search</p> <p>12 AUGUST 1991</p>
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Documents considered relevant following a search in respect of claims

1 at least

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2238405 A (SHIMIZU CONSTRUCTION) - whole document	1 at least.
Y	EP 0043668 A1 (NIPPON DENSO) - eg Figure 1	1 at least.
Y	WO 89/12269 A1 (HONEYWELL) - eg Figure 5, abstract	1 at least.
Y	US 4872397 (DEMETER ET AL) - whole document	1 at least.
Y	US 4850264 (KISER) - whole document	1 at least.
Y	US 4567939 (DUMBECK) - whole document	1 at least.
Y	US 4362922 (ANDERSON) - whole document	1 at least.
Y	SU 1297783 (CHELY AGRIC MECH) - eg WPI abstract, acc no. 87-290759	1 at least.
Y	SU 1124970 A (HEALTH RESORTS) - eg Abstract WPI Acc No. 85-133939	1 at least.

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).